sometimes be removed in this way; but if we consider that a greatly increased supersaturation (six-fold instead of four-fold) is necessary, and that the production of ions is continually going on, so that negative ions as well as positive are always present, we can hardly consider it a likely occurrence. What then is the subsequent history of the positive ions after being carried up out of reach of the drops formed on the negative ions? They will, under the action of the electric field produced by this separation, tend to travel downwards relatively to the air with a velocity of the order of one centimetre per second for a field of 100 volts per metre, as the measurements of Rutherford and others have shown. After being carried beyond the region of ascending air-currents, they will travel downwards towards the earth's surface; but long before reaching it they will become attached to cloud particles or to the dust particles of the lower layers of the atmosphere, where the positive charge will accumulate.

It is not claimed that the process described above is the only source of rain or the only source of atmospheric electricity. It should be pointed out, for example, that another way in which rain may possibly acquire a negative charge is by falling through ionised air. For according to Zeleny (*Phil. Mag.* vol. xlvi. p. 135) a body suspended in a current of ionised air becomes negatively charged in virtue of the slightly greater velocity of the negative than of the positive ion under a given force. Elster and Geitel make use of this difference between the positive and negative ions to account for the normal positive electrification of the atmosphere, by the passage of air through the vegetation on the earth's surface. Whether, however, the charged particles, the presence of which near the surface of the earth their experiments seem to prove, are really free ions whose velocity under a given force is that of the ions produced by Röntgen and other rays and not comparatively slow-moving masses (the nuclei called dust particles by Mr. Aitken) to which ions have attached themselves remains as yet undecided. In air charged with dust even to the extent to which clear air near the surface of the ground is shown by Mr. Aitken's observations to be, it is likely, since the rate of ionisation in the atmosphere is certainly slow, that an ion would become attached to some dust particle in a time very short compared with what the average life of an ion would be in dust-free air, where it is determined merely by the rate of recombination of the ions.

In conclusion, it must be confessed that if the rate at which the electric field of the earth is being destroyed by leakage through the air is anything like so great as is given by Elster and Geitel's interpretation of their experiments (*i.e.* of the order of 1 per cent. per minute), no theory which attributes the normal fine weather electricity to the effect of precipitation at a distance is sufficient to explain the facts. C. T. R. WILSON.

Cambridge Laboratory, Cambridge, May 16.

Specimens of "Dromæus ater."

IN reference to Prof. Giglioli's note (*suprà*, page 102), I may perhaps be allowed to remark that Bullock's Museum appears to have contained a specimen of the extinct *Dromaeus ater.* The twelfth edition of the "Companion" to that Museum, published in 1812, has the following entries (page 80):—

"Great Emea, or New Holland Cassowary . . .

"Lesser Emea, not half the size of the above, and a distinct species."

At the dispersal of his collection the sale Catalogue includes both specimens as lots 97 and 98 on the eleventh day of the sale (May 18, 1819), the latter as

> "Lesser Emew, a distinct species from the last,"

and my annotated copy of the Catalogue shows that both were bought by the Linnean Society—for 10*l.* 10*s.* and 7*l.* 10*s.* respectively. I have tried to trace the latter specimen, but in vain. It may still exist unrecognised. ALFRED NEWTON.

Magdalene College, Cambridge, June 4.

Effect of Iron upon the Growth of Grass.

SOME years ago NATURE published a short letter of mine from India, noticing the way in which laying out iron (famine) tools on the ground brought on grass upon very dry surfaces. Any one who looks now under the rows of iron chairs, and round the railings, of the band-stand on the east side of the Green Park, will see the same stimulating effect produced. A. T. F.

London, June 4.

SOURCES AND PROPERTIES OF BECQUEREL RAYS.

IN the following article a general account is given of a few of the more striking phenomena connected with Becquerel rays, including some of the recent developments of the subject at the hands of Becquerel, M. and Mme. Curie and others.

Among a large number of papers which have lately been published, dealing with properties of these rays, two are worthy of especial notice, as giving a comprehensive view of the phenomena. For those who propose to study the subject more fully, no better guide can be found than Prof. Elster's report in Eder's *Jahrbuch für Photographie und Reproductionstechnik* for 1900. The footnote references to original papers form a complete bibliography of the literature of the subject existing at the time when the article appeared, and it is surprising that Prof. Elster should have succeeded in summarising so large an amount of matter in eleven very small pages. Dr. B. Walter's article in the *Fortschritte auf dem Gebiete der Röntgenstrahlen* is somewhat less condensed and more popular; the chief phenomena, especially the photographic and fluorescent properties, are dealt with at greater length, and the article is illustrated by a plate of radiographs showing the difference between the actions of Becquerel and Röntgen rays. Already Walter's paper, and, to a less degree, Elster's report, have become out of date on the subject of magnetic deviation, and for this and other later developments no better guide could be found than the well-condensed summaries contained in the current monthly parts of *Science Abstracts.*

The discovery of these rays in 1896 was a natural sequence of the discovery of the Röntgen rays, and was led up to, on the one hand, by the attempts of M. Henry to intensify the action of Röntgen rays by the use of phosphorescent substances; and, on the other hand, by the theory, since abandoned, that the Röntgen rays were themselves the result of phosphorescence of the vacuum tube. Becquerel and other physicists made numerous experiments to test whether phosphorescent substances emitted rays capable of acting on a photographic plate that was enveloped in opaque paper, and it was found that rays which produce actinic action were emitted by the phosphorescent salts of uranium, not only when these salts had been exposed to the action of sunlight or of Röntgen rays, but even after they had been kept in the dark for months, the "radio-activity" showing no perceptible falling off.

The next step was the discovery, by Mme. Curie, that Bohemian pitch-blende—a black, shiny ore of uranium—possessed a higher degree of radio-activity than uranium itself, and this result naturally suggested the view that the ore contained, besides uranium, some other substance to whose presence the increased action was due. By separating the pitch-blende into its constituents, M. and Mme. Curie were led to discover the existence of two sources of radio-activity, one associated with the compounds of bismuth, and the other with those of barium occurring in the ore. Seeing that barium and bismuth obtained from other sources do not emit Becquerel rays, these radiations were attributed to the existence of two new substances, that associated with bismuth being named polonium, a name derived from the Polish nationality of Mme. Curie, while the other substance associated with barium chloride was called radium. The separation of these two substances has led to the production of rays of sufficient intensity to excite fluorescent screens, discharge electrified conductors, and, indeed, to reproduce, with differences, most of the properties of Röntgen rays. A third radio-active substance, produced from the residues of pitch-blende, is recorded by Debierne, who names it actinium. It is precipitated by the principal agents for titanium, and it emits rays which reproduce the same phenomena as the rays emitted by radium and polonium, and are 100,000 times the intensity of ordinary uranium rays. Certain thorium compounds are also radio-active, a property first established in these by G. C. Schmidt and Mme. Curie, and subsequently investigated by R. B. Owens and Rutherford.

Since this article was in the printer's hands a paper by Sir W. Crookes on the radio-activity of uranium, read before the Royal Society on May 10, has been received. The author records an entire absence of radio-active effects in all the barium minerals in his cabinet from which uranium was absent, while pitch-blende and other minerals containing uranium and thorium excited a photographic plate. Arrangements were then made for working up half a ton of pitch-blende, and the radio-activity of the uranium salts was definitely traced to the presence of a foreign body, which Sir W. Crookes has christened for the time UrX (*i.e.* the unknown quantity in uranium), following a fashion initiated by Röntgen, and which has previously led to the introduction into our vocabulary of such terms as "Xd air" (Italian "aria Xata" or *ixata*). We would suggest the name "Crookesium" as a substitute. Whether uranium-X is or is not identical with radium seems not fully decided, but it appears to be distinct from polonium. It is now proposed to try to separate the radio-active component of thorium.

Le Bon, who claims to have anticipated the Becquerel rays in his "lumière noire," has expressed the opinion that the properties attributed to radium and polonium do not prove the existence of new elements, and may be accounted for by supposing the radio-active substances to be mere allotropic modifications of bismuth and barium. On this view there is no more fundamental difference between the properties of radio-active and ordinary barium than between phosphorescent and ordinary sulphuret of lime. Giesel, of Brunswick, also has adopted the terms "radio-active barium" and "radio-active bismuth" in preference to "radium" and "polonium." In support of the opposite view, Demarçay has proved that radium possesses a characteristic spectrum, and M. and Mme. Curie find that the atomic weight of radio-active barium chloride is greater than that of ordinary chloride, amounting in one specimen to as much as 146 as against 137.

The pitch-blende used in the preparation of these substances is obtained from Joachimsthal, in Bohemia. Under the direction of Giesel, working in co-operation with Profs. Elster and Geitel, the firm of E. de Haën, of List, near Hanover, have undertaken the preparation in small quantities of radio-active barium emitting rays that are unequalled in intensity, and have also placed on the market cheaper by-products which also emit rays of sufficient intensity to visibly excite a fluorescent screen. The solid radio-active compounds of barium increase in activity from the time of solidification, but do not reach their maximum for more than a month. The barium preparations are all luminescent, the chloride and bromide especially so when dry. According to Giesel, the bismuth or polonium preparations lose their radio-activity in a few weeks, and this property is also cited by Elster.

The radio-activity of barium bromide is found by Elster not to be destroyed by continuous heating for twenty-four hours *in vacuo*. After cooling, the strength is much reduced, but is restored after the lapse of a few days to nearly the original intensity.

Becquerel rays resemble Röntgen rays in their power of "ionising" air, a property they possess to such a degree as to discharge all conductors within a considerable distance of the radio-active substance. Their action on electric sparks has been studied by Elster and Geitel. A spark gap 1 cm. wide, consisting of a positive knob and a negative disc, was exposed to the radiations from a barium preparation. The sparks or brushes were converted into a violet glow-discharge, but the former discharge was re-established on interposing a plate of lead. With discs made of semi-conducting card the radium affected the discharge at the distance of over 1 metre. According to Elster, heating a small trace of a radio-active substance in air in a Bunsen flame increases the electric dispersion of the air of the room.

Becquerel finds many bodies acquire the temporary power of discharging conductors under the influence of the rays, thus affording proof that these rays involve a continuous emission of energy. The bodies do not, however, act on a photographic plate, and their activity is lost on heating. This property is not assumed by the double sulphate of uranium and potassium.

There appears at present no prospect of utilising Becquerel rays as a substitute for Röntgen rays in surgery. The difference of behaviour of the two kinds of rays is well shown by two radiographs of the human hand accompanying Dr. Walter's paper. In the one taken with Röntgen rays the outlines of the bones are remarkably clear and sharp; in the other, taken with the rays emitted by Giesel's most powerfully radio-active preparations, a dark, ill-defined shadow of the outline of the hand is seen, but not a trace of the bones is visible. This latter radiograph, which was taken with the relatively short exposure of an hour, shows clearly the shadows of a needle and of a coin that were placed under the middle of the hand, proving that a certain proportion of the rays had actually passed through the hand, but without differentiating the bones from the rest. Experiments undertaken by Walter to account for the hazy outline of the Becquerel radiographs point to the conclusion that the Becquerel rays, when passing through substances of small atomic weight, experience a far greater diffuse scattering than Röntgen rays. Further, the secondary radiations emitted by both light and heavy substances under the influence of the Becquerel rays differ far less from the incident rays in intensity and penetrability than in the case of the secondary rays investigated by Sagnac in connection with Röntgen rays. A further difference lies in the far greater absorption of Becquerel rays by specifically light substances, such as those forming the flesh of the human hand. With the use of a platinocyanide of barium screen, Walter observed the same absence of all traces of bones as with photographic methods, although the shadow of the hand was clearly seen on the screen.

The composite nature of Becquerel rays is suggested by experiments on phosphorescence and selective absorption, as well as on magnetic deviation. Mme. Curie has found that Becquerel rays are more easily absorbed when they have already penetrated an absorbing layer than when they have not. One aluminium disc absorbed a certain proportion of the rays; a second aluminium disc absorbed an even greater proportion of the remainder. According to the note on Mme. Curie's paper in *Science Abstracts*, "this is due to the fact that the less penetrative rays are absorbed in the first absorptive layers," but such a view would more naturally lead one to expect that the proportion of absorbed rays would be less at the second screen than the first, instead of greater; the phenomena can, however, be accounted for by the hypothesis that the first screen transforms the rays into secondary rays of lower penetrating power. The existence of such secondary rays has been supported by Villard, Meyer and Schweideler, Dorn and others. Becquerel has, however, shown that in the case of polonium rays from the Curies' preparations, no secondary rays are emitted by aluminium. The phenomenon of selective absorption has been studied by Becquerel, who exposed various substances to the action of radio-active barium chloride, including hexagonal blende, platinocyanide of barium, diamond, and double sulphate of uranium and potassium. The phosphorescence varied in different cases. When different screens were interposed—namely, aluminium, mica, black paper, glass, ebonite and copper—the absorptions of the radiations which excite phosphorescence in different substances by the same screen were found to be unequal. R. B. Owens has shown that thorium radiations resemble those associated with the derivatives of uranium ore, but possess greater variety. There are indications that they are not confined to so few distinct types, if, indeed, the number of types is limited. Becquerel shows that the absorption of "radium" rays by screens is variable according to the distance of the screens from the source, and that the intensity of the radiation decreases with the distance more rapidly than it would do according to the law of the inverse square; both of these are results of absorption by the air. The view advanced by Le Bon two years ago, that Becquerel rays could not be polarised, has been confirmed by Rutherford.

The magnetic deviation of Becquerel rays has absorbed a large amount of attention during the last few months, and conclusions from recent experiments have in several instances been in contradiction with the inferences from earlier investigations. Thus a survey of the literature of the subject shows that amongst others the following views have been advanced: (1) that Becquerel rays are not deviated; (2) that they are deviated in air but not *in vacuo*; (3) that the deflection gives rise to phenomena which are more marked with polonium than with radium; (4) that both radium and polonium rays are deviated *in vacuo*; (5) that radium rays show marked deviation, but polonium rays show no deviation whatever. The first negative result was obtained by Elster and Geitel; Giesel proved the magnetic deflection of the rays in air, and attributed the previously observed absence of deflections to the experiments having been performed *in vacuo.* Elster, by repeating the experiments with a different arrangement of apparatus, using the same radio-active bismuth and barium as in Giesel's experiments, has discovered the cause of his previous failure, and has established the magnetic deflection of the rays *in vacuo.* Giesel used a strongly radio-active bismuth preparation, and got more marked effects than with his barium compound; Elster, using a similar bismuth preparation and a relatively feeble one of barium, was led to infer that the barium radiations were the most deflected. In these experiments the rays are received on a photographic plate or fluorescent screen; P. Curie, on the other hand, has described an apparatus for comparing the magnetic deviation by means of the electro-dispersion produced by the rays. When not deviated the rays pass out normally between two lead blocks, and traverse the space between the plates of a condenser, causing a current to flow; when deflected the rays are absorbed by the lead blocks, and the current ceases.

Both Curie and Becquerel find that the magnetic deflection varies with different substances. According to Becquerel's paper of December 26, polonium showed no deflection, while radium showed a strong deflection. The absence of deflection in polonium rays has been observed by Mme. Curie, who states that they travel in a straight line. In comparing these results with the different conclusions obtained by Elster, reference must be made to Dorn's hypothesis, according to which it is suggested that the primary rays are not deflected, but are transformed into deviable secondary rays. But in a recent paper Becquerel finds that the Curies' polonium rays are neither deflected by a magnetic field of 10,000 C.G.S. units, nor are they transformed into deviable secondary rays. He has also made experiments to test whether the curvature of radium rays is affected by interposing a screen, as would occur if the transmitted rays were secondary rays moving with lower velocity. No such effect has been as yet observed. The most probable inference at present is that there are two kinds of rays, one deviable and the other not. The Curies find both forms coexist in radium rays; and from Giesel's experiments the deviable rays certainly exist in some preparations of polonium, but were doubtless not present to an appreciable extent in the samples experimented on by the Curies and Becquerel. According to Curie, the rays from radio-active barium carbonate are deflected to a very different extent. Those rays which have the greatest penetrative power are the most easily deflected, and those rays which are not deflected only penetrate air to a distance of 6 or 7 mm. Becquerel finds that magnetically deviable rays are absorbed by different screens up to a certain inferior limit of distance, while they penetrate a screen that is placed sufficiently near the source.

When the magnetic field is uniform and the direction of the rays is perpendicular to the lines of force, they describe circles and return to the starting point; when the rays start in a direction oblique to the lines of force, the paths are helices. These results have been recently verified by Becquerel, and from them it is possible to form a general prediction of the corresponding effects produced in a non-uniform field, such as that produced by a horseshoe magnet, which effects we now proceed to describe.

In Giesel's experiments, the sensitive plate was laid on the poles of the magnet, film downwards, the polonium being placed below and in contact with the film. Between the black patch produced above the substance and the dark zone produced by the deflected rays, a number of dark traces were observed, resembling wavy hair or like the ramifications in Lichtenberg's figures. Becquerel has shown that when the radio-active barium is placed on one pole of an electromagnet and a fluorescent screen on the other, the effect of exciting the magnet is to concentrate and contract the luminous area, a result unaltered by reversing the poles. When the rays pass across the lines of force, they, after proceeding upwards, are bent round and impinge on the plate along a curve, which extends from one pole to the other, bending out of the way of the radiant substance in the centre. When a piece of radium preparation is placed on a plate in a uniform field near a plane normal to the lines of force, the result is an intense impression limited by a spiral whose sense is that of the current which produces the field. This spiral is the trace, deformed by the field, of the line of intersection of the vertical plate and the plate on which the radium rests.

In the *Journal de Physique* for April, Becquerel shows that different radio-active compounds of barium emit rays that are equally deviated, and he establishes the fact that the deviation conforms to laws similar to those which apply to kathodic rays. The phenomenon of dispersion is established, and by interposing strips of paper, aluminium and platinum against the gelatine plate, on which the deflected rays are received, a kind of absorption spectrum is obtained, showing that the most deviable rays are the most readily absorbed under the conditions of the experiment. By calculating an inferior limit to $H\rho$ (the product of the magnetic force and the radius of curvature of the path) for the rays transmitted by various screens, the absorption by different substances is compared, and the results are of the same order of magnitude as for the kathodic rays. These and other facts suggest that part of the radiation is of similar nature to the kathodic rays, where small negatively-charged masses are transported with great velocity, and the Curies' experiments prove the existence of such charges, which, however, are exceedingly feeble. According to this view, the magnetic deviation is given by the formula $vm/e = H\rho$, and in an electrostatic field of intensity F the rays ought to undergo a deviation, $\theta = Fl \div (v^2m/e)$, l being the length of the path. It appeared, at first, that the electrostatic force required to make any such deviation visible would exceed the limit for which disruptive discharge would take place in air, and could only be obtained *in vacuo*. In a footnote, however, Becquerel tells us that he has since observed the electric deviation in air with a field of about 10^{12} C.G.S. units, and has found for certain rays which pass through black paper the values $m/e = 10^7$ and $v = 1{\cdot}6 \times 10^{10}$.

The chemical effects of Becquerel rays have been examined by M. and Mme. Curie and Becquerel; they may be briefly summarised here. The rays from active salts of barium transform oxygen into ozone, a process involving a continuous expenditure of energy. Potassium iodide is coloured blue. Glass in contact with the salts is coloured violet, ultimately becoming nearly black, and the colour penetrates the glass; this phenomenon is analogous to the coloration of fluorspar by kathodic rays. Platinocyanide of barium screens gradually turn yellow, then brown, and finally lose their fluorescence, which, however, is restored by exposure to sunlight. Fluorine continues to phosphoresce for twenty-four hours after being excited, and calcined fluorspar which has lost its phosphorescence regains its luminosity in the presence of radium. Chemical activity is confined to those radio-active preparations which are luminous, but is not always proportional to the luminosity.

According to the Curies' experiments, powerfully radio-active compounds of radium and polonium, when they act on inactive substances, are able to communicate radio-activity to them. This induced radio-activity increases with the time of exposure up to a certain limit. If the inducing substance is 5000 to 50,000 times the activity of uranium, the induced activity may amount to fifty times that of uranium. It is reduced to one-tenth of its amount in an hour after removal, but it may persist for many days, finally disappearing. The emanation of radio-active particles from thorium compounds, investigated by Rutherford, is remarkable. This emanation ionises the gas in its neighbourhood, and it will pass through thin layers of metal, through thicknesses of paper, or through a plug of cotton wool. It is also unaffected by bubbling through hot or cold water, weak or strong sulphuric acid. The emanation retains its radio-active power for some minutes, gradually losing it. The positive ion produced in the gas by the emanation was found to possess the power of inducing radio-activity in all substances on which it fell, this power of giving radiation lasting several days. Whether the emanation be a vapour of thorium is doubtful.

The question as to the amount of energy emitted by the Becquerel rays has already been referred to in NATURE, and need not therefore occupy our space further now. The problem of discovering the seat of this energy would seem of late to have taken another form. At first it was supposed that a difficulty would exist in reconciling the continuous emission of these rays with the principle of conservation of energy; now, however, that the amount of the emitted energy has been estimated, the difficulty is seen to lie in the experimental observation of changes of such inappreciable magnitude as would suffice to generate this energy.

Before 1896 physicists were just beginning to grasp Maxwell's theories, and to realise more clearly the simplification introduced into notions electric and optical by the conception of the ether. The discovery of rays capable of discharging electrified bodies in air has not only shown the fallacy of our preconceived dogmatic notions as to the division of substances into conductors and dielectrics, but has taught us that the properties of the ether are not so simple as we had anticipated. We can only wonder whether Maxwell would have been able to develop his electromagnetic and electro-optic theories had the complications arising from Becquerel and other rays been before him, and the want now makes itself felt of a second Maxwell, who shall co-ordinate the newly-accumulated mass of experimental facts into the form of a connected mathematical theory.

G. H. BRYAN.

MODERN MICROSCOPES.[1]

IN spite of the attention which has of late years been paid to the improvements of every detail of microscope construction, it is remarkable how Powell's No. 1 stand has now existed, practically unchanged, for some fifty years. It may therefore be considered a permanent type, and it is one to which the best modern instruments conform more and more. Its most obvious peculiarity, however, a tripod base, has not yet become general. The heavy horseshoe foot is still in all but universal favour on the Continent, although Powell's base is occasionally imitated. Thus the Leitz firm in 1893, and the Hartnack firm in 1898, brought out large model microscopes on a tripod base; Greenough's low-power stereoscopic binocular microscope (1898) is similarly equipped. This last instrument, which is the most recent binocular novelty, is highly esteemed. It is made by Zeiss, is fitted with porro prisms, and, among other advantages, affords views of the *under* as well as the *upper* side of an object.

English makers have lately paid much attention to the perfecting of cheaper stands with some excellent results. In their new model and educational microscope, Messrs. Ross have reintroduced the principle of a reversing and locking foot, which was first invented by Cuff (*circa* 1765). By this means the instrument acquires great stability when used horizontally. The same firm, in their bacteriological microscope, use a tripod stand, of which the hind toe is made to fold forward between the two fixed front toes when not in use, thereby economising space in packing. The stage of this, as well as of Baker's microscopes, is fitted with the Nelson horseshoe perforation. The advantage of this device is that in high-power work, when the objective necessarily works very close to the cover glass, the slide can be tilted with the finger, and the focus gradually attained with far less risk to the object than if the slide rested immovably on the stage.

Messrs. R. and J. Beck's student's microscope and Messrs. W. Watson's "Fram" microscope are other examples of really good, small, cheap microscopes. Economy is obtained, not by sacrificing quality of work, but by simplifying the design. Every step in the direction of reducing the cost of a good instrument is too obviously desirable to require demonstration. Some designs strive after cheapness by using a fine adjustment, and trusting to a push-tube motion for the coarse. But if a microscope is to have only one adjustment, most microscopists will prefer a good coarse to an indifferent fine adjustment. This is the principle of Messrs. Watson's school microscope, which has a coarse adjustment only (diagonal rack and pinion), so good that a $\frac{1}{8}$-inch objective can be accurately focussed with ease. The cost, with eye-piece and objectives, is only three pounds.

The practical difficulty is, of course, that the great amount of wear upon the coarse adjustment affects in time the evenness of the racking, and produces loose action. But an important piece of progress towards obviating this trouble has been made by Mr. E. M. Nelson, who has applied the principle of stepped rackwork (Fig. 1). The two similar racks are placed so that their teeth are slightly out of step, the amount of divergence being regulated by the upper right-hand screw. The two screws in the centre of the pinion regulate the pressure by which the pinion is forced into the rack. The advantage of the arrangement is not only compensation for wear and tear, but rapidity and smoothness of action, for the tube obeys the slightest movement of the milled heads. If experience confirms the favourable opinion with which this novelty has been received, the necessity of a fine adjustment in cheaper stands will disappear.

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[1] Fuller accounts of all the instruments referred to will be found in the *Journal* of the Royal Microscopical Society for 1897, 1898, 1899 and 1900.